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     Grant Title...........: A Distributed Computing System Supporting
                             Near Earth Asteroids Research
     Report Type...........: progress (year 1 of 3)
     Principal Investigator: Pasquale Tricarico
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     Institution...........: Planetary Science Institute
                             1700 E. Ft. Lowell Rd., Suite 106
                             Tucson, AZ 85719, USA
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During this first year of performance we have successfully completed the following tasks:

1. acquired and installed the computing equipment;
2. deployed and tested the distributed computing infrastructure;
3. developed the first scientific application;
4. performed initial Monte Carlo simulations.

The computing equipment acquired is an HP Proliant DL380 G5 rack server, with two quad-core Intel Xeon CPUs and 8 GB of memory. The disk space is provided by two RAID arrays with fast SCSI interface and a total capacity of 140 GB and 400 GB. Redundant power supply and fans, a dedicated UPS unit, and 4 years of warranty complete the system. Data backup is provided by the institute's IT department.

The system developed is based on the BOINC[1] infrastructure for distributed computing, developed at Berkeley and adopted by the most successful projects around the world. BOINC provides all the services, web pages and software libraries necessary to build a generic state-of-the-art distributed computing project. As an open-source project, it is continuously updated and expanded by volunteers, and this requires frequent updates and consistency checks. Our distributed computing project is now called **orbit@home**[2] and counts more than 3,700 volunteers donating computing time on more than 7,000 computers.

After the deployment of the distributed computing system, we've started to develop our first scientific application, called *SurveySimulator*. This application allows the simulation of surveys searching Near Earth Objects (NEOs), in an extremely flexible environment. An arbitrary number of surveys can be simulated concurrently, using a NEOs population with parameterized distributions in the orbital elements space and in the absolute magnitude dimension. All the main characteristics of each survey can also be modeled, such as the period of performance, limiting magnitude, field of view, pointing constraints (minimum elevation, minimum distance from Moon, and minimum Moon phase), duty cycle time (minimum time between two consecutive observations), recycle time (minimum time between two observations of the same sky position). But the main characteristic of each survey is given by the

[1] http://boinc.berkeley.edu/
[2] http://orbit.psi.edu/

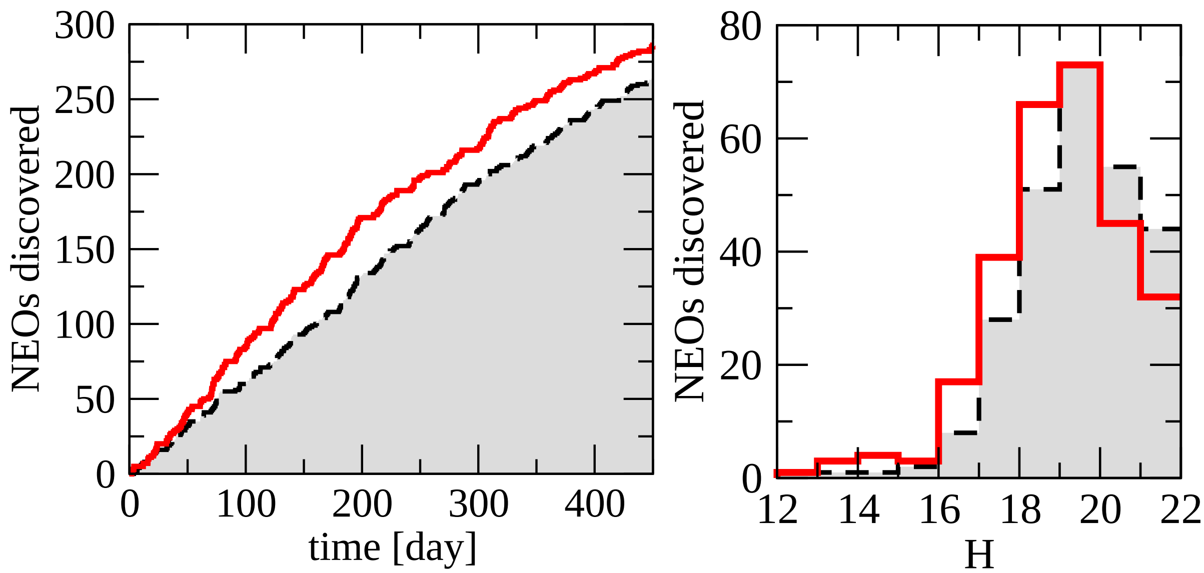

Figure 1: The opposition (black) and sieve (red) scheduling yield to different discovery performances (left) and affect the NEOs population in slightly different ways (right). An initial period of 5 years of opposition scheduling has been simulated (not displayed), to build a common history of observations of NEOs.

set of rules that determine its scheduling, and we're now testing two set of rules: *opposition* and *sieve*. The opposition scheduling is characterized by a choice of sky fields that stays as close as possible to opposition (the point in the sky that is 180 degrees from the Sun). The sieve scheduling uses a control population of synthetic NEOs to determine at any time what is sky patch where it is most likely to discover a real NEO. Both scheduling approaches respect at all times all the pointing constraints described above.

We've then started to simulate different scenarios to test whether the sieve scheduling, proposed by us as an improved scheduling over the opposition approach, effectively performs consistently better than its alternative. These simulations typically cover a period of several years (5 to 20), about 10^4 real NEOs, and 10^5 to 10^6 synthetic NEOs for the sieve scheduling. Initial results are showed in Figure 1, where the sieve scheduling consistently outperforms the opposition scheduling over the simulated period (left) and also tends to discover brighter NEOs (right). Both results make the sieve scheduling very attractive, and we plan to present[3] detailed results from our simulations at the ACM meeting in Baltimore, MD on July 17th, 2008.

[3] http://www.lpi.usra.edu/meetings/acm2008/pdf/sess606.pdf